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AUTHOR Lindsay, Robert M.
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ABSTRACT

A 4-week experimental study was conducted with 105 high school students in 4 introductory typewriting classes of a large urban school in British Columbia during the 1981 spring semester. The purpose of the study was to compare the effectiveness of teaching the skill-building components of typewriting speed and accuracy using either the microcomputer or the electric typewriter. Ten hypotheses were tested using a randomly selected treatment group of 32 students and a control group of 73 students. The nonequivalent control-group design modified by a time-series design was used. Two pretest and posttest speed and accuracy assessments were measured by instruments certified by a panel of typewriting experts and the results evaluated through statistical techniques. The experimental group used a custom-designed software program, essentially a copy of text material used by the control group. Student and teacher questionnaires were administered. Results failed to reject 9 out of 10 null hypotheses, indicating that the microcomputer is as effective as the electric typewriter in increasing student speed levels considering factors of sex, age, and class attended. The results also indicate that the microcomputer is as effective as the electric typewriter in increasing accuracy scores when age and class attended are involved. Recommendations for microprocessor design and future research were made. (Author/KC)

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A COMPARATIVE STUDY OF TEACHING TYPING SKILLS ON MICROCOMPUTERS

Robert M. Lindsay

EDUCATIONAL RESEARCH INSTITUTE of british columbia

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Telephone: 873-3801

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A COMPARATIVE STUDY OF TEACHING TYPING SKILLS ON MICROCOMPUTERS

by

ROBERT MCDONALD LINDSAY

B. Comm., The University of British Columbia, 1960
M.A., The University of British Columbia, 1982

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ABSTRACT

A four week experimental study was conducted with 105 junior secondary students in four introductory typewriting classes of a large urban Vancouver school during the Spring semester of 1981. The purpose of the study was to compare the effectiveness of teaching the skill building components of typewriting speed and accuracy using either the microcomputer or the electric typewriter. The study also addressed the suitability of the microprocessor selected for typewriting instruction. Ten hypotheses were tested using a randomly selected treatment group of 32 students and a control group of 73 students.

The nonequivalent control group design modified by a time series design (Campbell & Stanley, 1963) was used. Two pretest and posttest speed and accuracy assessments were measured by instruments certified by a panel of typewriting experts and the results treated with analysis of variance and covariance statistical techniques. The experimental group used a custom-designed software program (Braun, 1981) which was essentially a copy of the skill building text material used by the control group. A student and teacher questionnaire was administered.

The results failed to reject 9 of the 10 null hypotheses indicating that the microcomputer is as effective as electric typewriter in increasing student speed levels when factors of sex, age and class attended are considered, and as effective as the electric typewriter in increasing accuracy scores where age and class attended are involved. In the rejected hypothesis, significance at the $p<.01$ level indicates that males of the treatment group did not achieve error rates as low as either the control group males or the females in the treatment group.

Recommendations for microprocessor design and areas for future research were based on the findings.

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A COMPARATIVE STUDY OF TEACHING TYPING SKILLS ON MICROCOMPUTERS

I. THE PROBLEM

Microcomputers are literally invading the public schools, and many schools are piloting new programs on microcomputers. For instance, during 1980, the British Columbia Ministry of Education placed 100 microcomputers in various public schools for pilot programs. Other jurisdictions placed as many as 1000. Cases in point are the Minnesota Educational Computing Consortium which oversees more than 1000 microcomputers since 1979, and the Ministry of Education in Alberta which plans to equip a total of 400 classrooms with 25 microcomputers each during 1982. With such numbers being thrust upon the schools, it is desirable to study the usefulness of microcomputers as educational aids or instructional support tools in regular classrooms. It was felt that a classroom which already featured a learning activity that could be easily transferred to a microcomputer would be suitable for a comparative study of the advantages of some of the features often touted as giving superior learning results, such as the possibility to immediately process and reinforce student responses. A nearly ideal setting for such a study can be found in a typewriting classroom, because a microcomputer can perform nearly all the tasks of a typewriter. Therefore, it can be used to teach typewriting - certainly beginning typewriting.

The purpose of this study was to compare the effectiveness of two methods of teaching typewriting skills. The achievement levels of an experimental group, learning to type on microcomputers, were compared

with the achievement levels of students learning on electric typewriters. In addition, both teacher and student reactions were collected by the questionnaire included in Appendix A. Student responses are recorded in the right margin.

Specifically, the study examined two basic typewriting skill components, speed and accuracy, which result from a teacher-directed skill-building instructional sequence. The study addresses the following questions:

1. Is the microcomputer as effective a classroom instructional tool as an electric typewriter when conventional skill-building, teacher-directed, techniques are used?

2. Is the equipment which was selected for this study (the COMMODORE Models 2001, 4016 and 4032 with cassette tapes) suitable for teaching introductory typing when conventional, accepted teaching methods are used?

Conventional methods of teaching typing refer to teacher-directed, timed drill and practice sessions which were only slightly adapted to take advantage of the special capabilities of the computer, such as comparing students' typed lines to correct lines, and calculating the typewriting speed automatically.

II. REVIEW OF THE LITERATURE

A revolution as important as the invention of printing is taking place in North America indicating that schools are acquiring computer and microprocessor technology on a modest scale (Melmed, 1982). He indicates that 52,000 microcomputer and computer terminals are in use in the United States. Similarily, the present state of microelectronics technology has been likened to that of oil in 1870 (Long, 1982).

These novel technological innovations create new concerns, among the most critical is "the inability of lawmakers and sociologists to cope with what is occuring, because no one knows where to begin" (Shane, 1982, p. 306). Other equally strategic decisions must address the following issues:

1. Striking a balance between what is technically possible using microelectronics and what is educationally desirable in the classroom.

2. Deciding upon the amount, content, and quality of the curricula to be stored electronically and what is to be used and in what fashion.

3. Selecting and training of specialists in producing instructional programs for the computer.

4. Reaction to physical demands of the new technology in terms of practice time, techniques of keyboard operation, possible physiological

effects, and the redefinition of the teachers' role.

Researchers are beginning to react to the issues created by this technology and its impact in the classroom (Malsam, 1982; Miller, 1982; Sturdevant, 1982; Zucker, 1982). Drill and practice computer programs providing individualized instruction in a variety of subject fields have been developed for large computers particularily in arithmetic and science. Since the microprocessor became available in 1975, little research for its use in the field of business education has taken place. Typewriting is the most popular business education course in terms of student enrolment, particularily the introductory course. How then, will the impact of the microcomputer effect the practices and methods in a typical typewriting classroom?

The introduction of microcomputers into the secondary schools' curriculum is accelerating (see, e.g., B.C. Business Education Curriculum Guide, 1979, p. 111; Collis & Mason, 1980; Taylor, 1981). The impact of this technology may need a re-examination and re-evaluation of instructional strategies, and an investigation of the assessment standards in vogue across North America (Reese, 1980; Simcoe, 1980; Wallace, 1981). Computing power is now within the grasp of even the smallest school budgets (Braun, 1979; Dewar, 1981; Drum, 1980; Dodds, 1977; Forrest, 1980; Tesch, 1980; Wishlow, 1980). Indeed, the implications of recent research on standards, strategies, and curriculum indicate that a re-examination is starting (see, e.g., Bauman, 1980; Goodrich, 1979; Lesson, 1975; McMullan, 1982; O'Dell, 1979; Pritchard, 1982; Radin, 1979; Seidel, 1980;

Stocker, 1981; Talsky, 1981; Wolfrum, 1980).

Since this study pertains to the teaching of typewriting, and does not include word processing, only the literature related to the utilization of microprocessors in typing classrooms is reviewed further.

Previous Research

While most agree that the growing popularity of the computer is altering educational concepts, research is currently failing to keep pace with the rapidly changing technology. An excellent historical review of the technological evolution of the computer was given by Pokrandt in an article published in 1981. However, no mention is made of the microprocessor. Similarily, in their review of the business classroom and laboratory equipment for the 1980's, Selden and Jorgensen (1981) omitted two major microcomputers, namely, (a) Apple II, and (b) IBM micro. Illustrating the rapidity of change, in a similar article one year earlier, Selden and Dilori (1980) made reference to the mini and standard computers only. Lower (1981) recognized a corresponding lack of curriculum and programs by lamenting the general absence of the essential software necessary to operate the microcomputer.

Little research on using the microcomputer in a typing classroom is available with the exception of articles in periodicals, and reports of action research. This is also true in other areas of business education. Much of the research is centered on the minicomputer, paced learning, Computer-

Assisted-Instruction (CAI), and any number of audio-visual technological marvels. Mosier (1975) pointed out that there is no research available which inhibits the use of the computer as an intructional medium.

References to the scarcity of suitable curriculum materials and in-service teacher-training programs abound (Joiner, Miller, & Silverstein, 1980; Licata & Inzinga, 1981; Shane, 1982). This theme was echoed by Alexander (1981) who specifies five vocational business education areas which are barren of adequate instructional and training materials.

Microcomputer Related Studies

In the traditional teacher-directed typewriting classroom, experiments involving many combinations of audio and visual electronic gadgetry have been examined for impact upon the learner. Rosenbloom (1979) designed an audiovisual tutorial typewriting program with the concurrance of a panel of experts in order to assess its effect upon typewriting theory, production, speed and accuracy. He discovered no significant difference in the resulting scores between the control and treatment groups. Studies by Blitz (1972) and Jackson (1976), when comparing the effect of CAI to a programmed text approach, resulted in no significant difference in the methods of instruction upon student scores. In 1976, Shirey, found no significant difference between a treatment group using computer augmented instruction and traditional instruction. All of these studies indicate that CAI methods are as effective as those in the traditional teacher directed classroom.

The use of electronic keycharts or electronic wallcharts produced no significant differences in speed and accuracy between the treatment and control groups (Guyot, 1973; McKown, 1979; Shaffer, 1976).

In the field of television and motion picture film loops, which also utilizes a video screen, research data is presented to confirm that these media are as effective as the conventional instructional techniques (Pasewark, 1956; Stein, 1958).

Measurement of Typewriting Achievement

The main components of typewriting ability according to A Teaching Learning System For Business Education, (Popham, Schrag and Blockhus, 1975, p. 173), a leading teacher training text, are:

1. touch typewriting and the operation of machine mechanisms.
2. knowledge of word division, punctuation and spacing
3. straight copy speed and accuracy.
4. production ability.

The phase of typewriting learning of this study is the third component, that of acquiring straight copy speed and accuracy. Straight copy speed and accuracy instruction involves considerable drill and practice. This aspect of a repetitious drill allows a program to be prepared which is especially suitable for use on the microprocessor; the computer being an inexhaustible instructional tool. Thus, the effective use of the

microcomputer is measured by the gain in straight copy speed and a corresponding increase in straight copy accuracy.

The measurement of a student's typewriting speed and resulting accuracy has long been established as a major factor in assessing the degree of typewriting skill achieved (DiLoreto, 1956; Ehley, 1970; Gades, 1967; Grubbs, 1956; Lemaster, 1962; Pasewark 1956; Redfern, 1969; Stearnes, 1977; Weise, 1975; West, 1975).

Methods of Teaching Typewriting

Popham, Schrag and Blockhus (1975) stated that the majority of introductory typewriting textbooks present the keyboard during the first 5 to 15 lessons of the course. Following the identification of the initial keyboard positions, reaches and strokes, an intensive practice period occurs. This is the skill building period during which the student focuses upon technique improvements, while progressively improving both stroking and reaching motions.

It is during this period of typewriting learning that many repetitious straight copy practice drills are typed, varying in length of time from 1 to 3 minutes. This phase of increasing mastery of the typewriting skills is generally one month in duration (Popham et al. 1975, p. 174) and encompasses the main period of research for this study.

Scoring Procedures

There has been expressions of concern regarding the scoring of typewriting speed and accuracy. The focus of concern is whether to express the resultant speed and accuracy scores separately or as a composite - a single score equivalent of these two variables.

Composite scores result in numerous combinations which are difficult to compare from one study to another. Lessenbury and Crawford (1952) devised a composite score based upon International Typewriting Contest Rules, which is in use today.

However, West (1975) suggests "Always score separately for speed and quality of work. Never express the two in a single composite score" (p.26). This point of view has received popular support in the tenet "Measures of gross stroking speed have high reliability even in very short tests" (West, 1975, p.30).

Other researchers (Garry, 1967; Long, 1977; Tranquill, 1965; Weise, 1975) suggested in support of West, that the two separate skills to be measured are:

1. speed as defined by gross words
2. percent of accuracy

Thus, when comparing one study to another, the variables of gross speed

and percent of error are best kept separate to avoid confusion when analyzing results.

West (1975, p. 26), when describing typewriting assessment, has generally noted, "For all tests of a given kind, hold constant: test length, test difficulty, test instructions; and condition of equipment. Otherwise, one cannot attribute a change in score from one occasion to another wholly to a change in skill".

Pacing

Various researches failed to support the hypothesis that a form of self or group pacing of learning was a more effective speed and accuracy builder than the conventional classroom methods (Collings, 1979; Sherrill, 1975; Tranquill, 1965). However, Dupras, (1973) using an Automated Touch System, a multi-media, individualized approach achieved significance at the .05 level on the speed scores of the treatment group. Accuracy was not significantly different.

The use of the computer terminal for teaching typewriting has been researched. Early terminals were teletypewriters. Sydow (1975) discovered that the teletypewriter terminal was a great motivator for both the typewriting students and their teachers. He recommended that the students be introduced to the teletypewriter after the keyboard positions were learned.

With the present technology the terminal in use today is the Cathode Ray Tube (CRT), often referred to as a Video Display Terminal (VDT). While the radiation levels associated with this technology has occasioned concerns (Wallersteiner, Galbraith & Green, 1981), Stocker (1981) suggested that any keyboarding technology which does not include a CRT would be outdated. Hills (1980, p. 9) observes that "... we are all going to need to be able to operate keyboard terminals...". These studies indicate that a microprocessor must be operated in conjunction with a video screen.

Sex Differences

The variable producing the most conflicting findings concerns the sex of the students and the resulting typewriting speed and accuracy scores. As early as 1923, Bennet suggested that girls type more than boys but that their accuracy is the same as for the boys during the first 35 hours of instruction, or approximately one third of the course curriculum. Garry (1967) stated that girls typed consistently faster than boys at the same grade level. Error means were not significantly different. Lauderdale (1971) observed that females appeared to be more accuracy oriented than males, while the males appeared more speed oriented than their female classmates. Dupras (1973) found that girls typed faster than boys and that accuracy was not related to sex. Cook (1973) observed that females are more successful than males in beginning typewriting. In summary, the majority of the findings indicated that females were more successful than males where speed was concerned.

Age, Class Size, Race

Age is another factor which resulted in divergent findings. One point of view is that older students type more rapidly than younger students of the same sex (Garry, 1967). However, Blume (1978) observed that the grade level enrolled had no effect in terms of significant differences in gross words per minute typed. There was also no significant difference between three and five minute straight copy tests on gross words per minute or in error percentages.

The size of the class in which the student is enrolled made no significant difference upon the student's resulting typewriting speed or accuracy (Good, 1970). This study examined class sizes ranging from 61 students to classes with fewer than 26 students.

Finally, race was not significant as a factor relating to speed or accuracy (Bennet, 1923).

In conclusion the literature assists in defining the problem by clarifying a series of related factors for researchers to investigate. In the field of business education a history of examination of emerging technology is evident, with the microprocessor beginning to be an object of study. Methods of typewriting instruction, its measurement and scoring are suggested by previous research. Factors of sex, age, class size, produced divergent conclusions.

III. DESIGN OF THE STUDY

This study was designed to generalize the findings to a target population comprising the typewriting students enrolled in introductory typing classes in Vancouver. The 55,539 students in Vancouver are urban dwellers. As illustrated in Table 1, several national and ethnic groups are represented, with English as the mother tongue of 70 percent of the population. Vancouver with a population of approximately 500,000 people is the largest city in British Columbia and the center of an urban region containing 61 percent of the provincial population.

Population

Eric Hamber Secondary School, in Vancouver, was selected for the study as it was one of two Vancouver secondary schools organized into semesters, enrolling a heterogeneous student population of 1745. Using a semestered school ensured daily typing instructions and the optimal use of the microcomputers. The students are representative of the Vancouver population (see Table 1). The school attracts students from all communities within the city, but specifically from the Shaughnessy and South Cambie areas.

Hamber Secondary School enrolled 247 students in Typewriting 9 classes which were organized into two semester groups of 119 students

during the fall term and 127 students during the spring term.[1] This represents nine percent of the 2682 Vancouver students enrolled in beginning typewriting courses during the 1980-1981 school term. Vancouver secondary school enrolment is illustrated in Table 2. The ages fell between 14 and 15 years.

While the school is located in an upper middle class district, enrolment is open to students from other areas of the city. The school has extensive vocational education facilities, and for this reason it appeals to many vocationally-minded students. The typewriting instruction and classroom environment at Hamber were as one would normally expect a modern typewriting laboratory to be. There appeared to be nothing in the physical setting of the study which might impinge on its generalizability to other typing classes in the Greater Vancouver area.

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[1] Other secondary schools in the greater Vancouver region were considered. They were rejected for the following reasons:

1. insufficient project population
2. non-semestered secondary school
3. lack of electric typewriters in the typing laboratory
4. high incidence of non-English mother tongue population

Table 1

City of Vancouver, Project Areas,
Percent of Population By Mother Tongue

Language	Vancouver	Shaughnessy	South Cambie
English	70.0	87.0	73.0
French	1.5	.9	2.5
German	3.3	2.0	2.8
Italian	2.6	.4	.2
Chinese	7.8	3.2	6.7
Indo-Pakistani	1.5	.2	1.2
Other	13.3	6.3	13.6
	100.0	100.0	100.0

Figures obtained from 1976 census

Table 2

Vancouver Secondary Student Enrolment
September 30, 1980

Grade						
8	9	10	11	12	Special	Total
4224	4404	4815	4877	4600	1773	24693

Figures obtained from the Vancouver School Board

Selecting the Sample

The 127 students enrolled in Typewriting 9 were taught in four sections of about 32 students each. In order to minimize experimental mortality, a

number of students with a record of absenteeism in the typing classes were excluded from the sampling. Other exculusions included students with previous typewriting instruction and students recently immigrating to Canada. Students with a history of four or more absences during the first twenty school days would be more likely to drop out as the course progressed. Recent immigrants to Canada may not be experienced in receiving instructions in the English language. Students with prior typewriting experience are at significantly different speed and accuracy levels than are the beginners and may progress in dissimilar stages. Twenty-two students were excluded from the study for these reasons. The remaining 105 students were assigned to experimental and control groups using a table of random numbers. A summary of the sample is presented in Table 3.

Table 3

Sample Characteristics

Class	Grade		Enrolment by Sex		Exclusions		Treatment Group		Control Group	
	9	10	M	F	M	F	M	F	M	F
1	27	5	17	15	1	5	6	2	10	8
2	29	4	9	24	2	4	4	4	3	16
3	24	7	9	22	0	6	4	4	5	12
4	29	2	9	22	0	4	2	6	7	12
	109	18	44	83	3	19	16	16	25	48
	127		127		22		32		73	

Note: Exclusions based upon:
Absenteeism
Previous Experience
Recent Immigrant

Research Procedures

The non-equivalent control group design (Campbell & Stanley, 1963, p.47) was modified to include aspects of a time series design (Campbell & Stanley, 1963, p. 37). The design can be represented by the following matrix:

O_1	X	O_3	O_5
O_2		O_4	O_6

Letter '0' represents observations upon the project group. Letters subscripted with odd numbers represent observations of the experimental group, while the evenly subscripted letters are representative of control group observations. Letter 'X' represents the treatment. Both O_1 and O_2 are pretests, the remaining observations are posttests.

This design controls threats to interval validity from the effects of history, maturation, testing and instrumentation. A major threat to the internal validity of the study results from the interaction of selection and maturation. In controlling for this factor the aspects of the time series design assisted the researcher. The series of two posttests would assist in controlling this variable (Campbell & Stanley, 1963, p. 41). An additional threat to validity, regression, is controlled by avoiding the selection of subjects presumed to have extreme scores (Campbell & Stanley, 1963, p.5). Statistically, regression can also be controlled by analyzing the data using the method of covariance analysis (Campbell & Stanley, 1963, p. 49). Since

there were four classes available and the students were randomly selected after excluding possible extreme students, the threat posed by regression was thus minimized for this project.

An external threat to validity, the interaction of selection and treatment, was controlled by the fact that the computer had relatively narrow use in other school disciplines. Occasional use would be in a game format, probably at the student's residence, and would not require the strict physical sequences involved in the typewriting program.

The Hawthorne effect (Campbell & Stanley, 1963, p. 50) was somewhat controlled by the four week treatment period, during which time the novelty of being selected waned.

The interaction of testing and the treatment was controlled by using the pretest instruments prior to notifying any student of the impending study (Campbell & Stanley, 1963, p. 50). Additionally, the second posttest was one week following the termination of the treatment program and appeared unrelated to the project as classroom testing is a daily routine.

Finally, external reactive effects of the treatment were minimal as the project group did not have access to the project classroom except during their respective instructional periods.

Pilot Study

A pilot study was conducted at Steveston Senior Secondary School in Richmond, a suburban area of Vancouver.

As a consequence of this study, the computer program to be used by the experimental group was modified to include specific instructions for: (a) loading the typewriting program into the computer, and (b) running the typewriting program. These directions are included in Appendix B. In addition, several ideas for the introduction and presentation of the project to the teachers were compiled and are also included in the Appendix C. As a result of the pilot study, the student directions were attached to the top of the computer screen for operational reference.

Main Study

The research study followed accepted classroom practice contained in the provincially prescribed curriculum guide and standard, authorized, textbooks. For example, Farmer, Graham and Jenkins (1977) suggest a sequencing method for teaching typewriting. Exercises should develop: (a) the touch location of the alphabetic, numeric, and symbolic keys, (b) skills of increasing speed and a corresponding accuracy, (c) simple centering, (d) business letters, (e) statistical tables and so forth. This sequence is supported by Rowe, Lloyd and Winger (1977) in their text, Typing 300.

The time required for building the skills of speed and accuracy varies from two to six weeks after the initial alphabetic keyboard locations have been introduced. Based on the experience of the researcher and the project teachers, a four week period was selected to provide time for the acquisition of a reasonable initial skill in both components.

The project teachers were well qualified and experienced business education teachers. Each teacher had a Bachelor of Education degree and had completed a program which included business education methods and curriculum.

Treatment Program Software

The treatment program consisted of computer skill building exercises based upon Rowe et al. (1977) theories of repetitious letter, word and sentence sequences. The software was designed to be flexible enough for teacher alteration or possible change of lesson plan while paralleling the actual lesson.[2]

The computer program consisted of three modes. Mode 1 contained three sub-sections: (a) pretest, (b) practice, and (c) posttest. This mode was designed to enable the student to type pretest material containing

---

[2] A program suitable for the task was developed with the assistance of Dr. Peter Braun, Faculty of Education, University of British Columbia from materials supplied by Mrs. Patsy Hinton, Business Education Department Head, John Oliver Secondary School, Vancouver, B.C.

one dominant letter of the alphabet for periods of one or two minutes. Following this, students typed material from the practice sub-section which stressed the dominant letter contained in the pretest. During the typing of this sub-section of Mode 1, the student strived to type each line without error. Following this practice section the pretest was retyped and the results automatically compared to the original.

At the conclusion of the three sections of Mode 1 the student received a message on the CRT which included the following: (a) the typing speeds of the pretest and the posttest, (b) the number of errors typed during the pretest and posttest displayed separately, (c) the number of error free lines typed during the practice sub-section, and (d) a short message of encouragement, as supplied by the project teachers and based upon the attained levels of speed and accuracy. A listing of these messages is included as part of the software in Appendix D.

Mode 2 of the computer program enabled the student to type a single line of text below a model line appearing on the CRT. This line recurred automatically and as frequently as required by the student. This mode was designed to assist the student to master a specific letter stroke by providing a repeated drill. In this mode the number of perfectly typed lines was recorded and appeared on the CRT.

Mode 3 of the typing program is referred to as the free mode, in that any text material may be typed as a drill. This mode was particularily useful during the warm up drills at the beginning of each lesson. It was also

useful as the student was able to practice material which was not included in the data banks of the program. This mode of the program was designed to caluculate and visually present the following information: (a) the number of lines typed, based on a 40 stroke line, (b) the speed of the student typing the drill, and (c) a short message of encouragement from the project teacher.

The experimental group was notified and met with the researcher in class groups during the first day of the study in order to familiarize them with the operations of the computer. The three instructional modes were explained at this time. A discussion of the purpose of the study began, however, no mention of a comparison with the control group occurred in order to avoid factors which jeopardize the internal and external validity of the study.

Treatment Program Hardware

To compare the effectiveness of microcomputers as a teaching device in typewriting classrooms, one should ideally equip a classroom partly with microcomputers and partly with electric typewriters. All other conditions of the typing laboratory can then be held constant for both the experimental group working on the micros and the control group working on the electronic typewriters. Due to financial limitations only eight microcomputers were available for experimental purposes.

Conti Electronics Ltd., a retailer in Vancouver, supplied eight

Commodore PET microcomputers and tape drives for the duration of the study. Three models were supplied: (a) five model #4016 (16K), (b) two model #2001 (32K), and (c) one model #4032 (32K).

Several physical problems were encountered using this configuration:

1. The tape drives took four and one half minutes to load the program whereas, disk drives accomplish the task in thirty seconds. This problem was outlined by Brown (1981).

2. The computer keyboard locations of numbers and special characters needed to be modified, making it comparable to the electric typewriter's keyboard.

3. Accidental striking of the RUN/STOP key, located near the letter 'p' erased the entire program from the memory of the computer, causing a reloading wait of four and one half minutes. This key was eventually disabled, rendering the computer's internal clock inoperable.

4. Valuable memory storage space was claimed during the reprogramming made necessary in solving problems 2 and 3.

5. Reprogramming the software to overcome operational problems increased its length to approximately 16K, thus limiting the encouragement messages suggested by the project teachers. This was a major problem using model #4016.

6. On occasion, a discernable time lag betweeen the key stroke and the appearance of the letter on the CRT caused confusion for the student operator.

7. The highly sensitive touch of the computer keyboard was a major problem. The slightest touch on a key would register.

8. The microcomputer model used in both preparing the software program and during the pilot study had an internal configuration of 3.2 BASIC. All of the leased project models were 4.0 BASIC. The programs are not immediately interchangeable. A computer malfunction resulted during the first day of student orientation.

Control Program

The control group followed the same instructional sequences as the treatment group except these students used the regular electric typewriter to develop their speed and accuracy skills. Their typing material was in printed form, but exactly the same as the text material found in the computer's memory banks. Control group students had to proof-read all of their exercises and had to calculate their speed and accuracy scores.

When centering exercises or business letters were included as part of the daily lesson the treatment group returned to their respective typewriters. This was only occasionally and would not exceed fifteen minutes in duration. It occured approximately two times per week.

Instruments

The pretests and posttests consisted of instruments designed to measure speed and accuracy. These instruments were selected from Rowe and Etier's (1967) supplemental drill and practice text. The material, which is included in Appendix E is similar to the provincially prescribed texts. The straight copy, narrative or manuscript form of material is most commonly used during one, two, or three minute sustained timed writings. This material was presented to a panel of five typewriting experts for comment regarding its suitability for use in this study. The instruments were certified as appropriate. The questions which were presented to this panel are contained in Appendix F.

It is common practice to supply a marking code consisting of a word count on this form of instrument. One word consists of five typing strokes. Thus letters of the alphabet, numbers, special characters, space bar or shift keys and punctuation marks are regarded as a keystroke. The total number of words typed is stated at the end of each line and a running score is presented in columnar form on the right of the narrative. Additionally, a sequential word count is horizontally displayed at the base of the copy. Total words typed are easily calculated by the student.

The administration time of each pretest and posttest was two minutes. This was a reasonable interval for typing tests for students with only one month of typing instruction (Typewriting Resource Manual, 1979). The time interval was increased to three minutes for the posttests as the students

progressed to longer sustained timed instruments after an additional month of instruction.

Each of the instruments used in the study contained 180 words. Since the study was conducted during the initial phase of the students' typewriting career it was felt that this length of instrument is satisfactory, and is supportable by its use in other researches (Typewriting Resource Manual, 1979, pp 8 - 12).

An analysis of Typing 300, (Rowe et al., 1977), the typing text used in the project classes, indicated that the students were typing material which had a syllabic intensity (SI) of 1.15. This indicates that there are 1.15 syllables, on the average, in every five strokes typed by the students. The greater the syllabic intensity, the more difficult it is to type. While this SI level is classified as fairly easy, the material is suitable for the novice typist. The Typewriting Resource Manual, (1979) indicated that the SI of typed material should increase as students advance in their course work.

The pretest instrument had a syllabic intensity of 1.17; the posttest instrument had a SI of 1.19, taking into consideration the expected increase in student skills.

The Flesch (1951) readability or level of difficulty of written materials was applied to the instruments. The resulting readability scores indicated that readability was not a factor in student achievement.

The pretest and posttest instruments were administered to the students in a format similar to the usual speed and accuracy instruments contained in the regular text (Rowe, et al., 1977) and related materials. All tests were administered on the electric typewriter. Students scored their results and submitted their test copy to their teacher.

Typewriting speed is calculated by dividing the total number of words typed by the length of testing time (Farmer, et al., 1977). For example, a student typed 43 words during a two minute test and the resulting score is 21.5 words per minute (43 - 2 = 21.5).

Accuracy, however, is determined according to the total number of identifiable errors typed or omitted by the student. Identifiable classifications of errors which generally occur during any typewriting task are included in Wong's (1971, p. 68) composite list.

Categories of inaccuracy are:

1. Capitalization - omitted or superfluous
2. Doubling of small words or syllables within a word
3. Letters - omitted or superfluous
4. Misspellings
5. Punctuation - omitted or superfluous
6. Spacing - incorrect, omitted or superfluous spacing between letters, words, lines, or paragraphs
7. Substitutions

8. Transpositions - of letters and words
9. Type face - wrong kind or type of face
10. Words - omitted

This composite listing, generated by Wong (1971) from four authors, was applied by the researcher in an unambiguous manner to identify student errors on the pretest and posttest instruments.

Hypotheses

1. There is no significant difference between the typewriting speed of students receiving four weeks of skill building instruction on microcomputers and the typewriting speed of students receiving four weeks of skill building instruction on electric typewriters as measured by straight copy tests.

2. There is no significant difference between the error rate scores of students receiving four weeks of skill building instruction on microcomputers and the error rate scores of students receiving four weeks of skill building instruction on electric typewriters as measured by straight copy tests.

3. There is no significant difference between the typewriting speed of male students receiving four weeks of skill building instruction using microcomputers and the typewriting speed of male students receiving four

weeks of skill building instruction using electric typewriters as measured by straight copy tests.

4. There is no significant difference between typewriting error rate scores of male students receiving four weeks of skill building instruction using microcomputers and the error rate scores of male students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

5. There is no significant difference between the typewriting speed of female students receiving four weeks of skill building instruction using microcomputers and the typewriting speed of female students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

6. There is no significant difference between the typewriting error rate scores of female students receiving four weeks of skill building instruction using microcomputers and the typewriting error rate scores of female students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

7. There is no significant difference between the typewriting speed of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using microcomputers and the typewriting speed of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of

skill building instruction using electric typewriters as measured by straight copy tests.

8. There is no significant difference between the typewriting error rate scores of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using microcomputers and the typewriting error rate of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

9. There is no significant difference between the typewriting speed of students belonging to different classes as measured by straight copy tests.

10. There is no significant difference between the typewriting error rate scores of students belonging to difference classes as measured by straight copy tests.

The elements of design summarized in this chapter described the target and sample populations, how the sample was selected, its characteristics, and which research designs were selected to conduct the study. This section also described the pilot and main studies and the components of its hardware and software (terms are defined in Appendix 6). Treatment and control group procedures are described in detail. A description of the instruments involved and scoring procedures used are outlined. The presentation of 10 testable hypotheses conclude the chapter.

IV. ANALYSIS AND INTERPRETATION OF THE DATA

The data consisted of scores for the speed and the error rate per minute achieved by the treatment and control groups in each of four classes. Thirty-two students comprised the treatment group that received typewriting instructions for one month on the microcomputer. The control group consisted of seventy-three students who received the same typewriting instructions on the electric typewriter. Since instruction was given in four sections of Typewriting 9, eight students from the treatment group received the same instructions during any particular class period as their corresponding eighteen peers belonging to the control group.

The measurement of individual words per minute and the number of errors per minute were recorded between February 26, 1981, and April 8, 1981. The speed testing occasions are referred to as S1, S2, S3, S4, representing the dates of February, 26, 1981; February 27, 1981; April 1, 1981; and April 8, 1981, respectively. The associated error measurement scores are referred to as E1, E2, E3, E4, respectively.

Definition of Dependent Variables

Two measures constituted the dependent variables:

1. Speed. A person's typewriting speed is generally measured in "words per minute". A word is defined as having an average of five keystrokes. Thus, a standard 60 character line contains twelve words.

In a three minute timed test, the number of five character fields typed is divided by three to obtain the average measure of words per minute.

2. Errors. The total count of errors made during the three minute timed test is divided by three to obtain the average errors per minute.

Definition of Independent Variables

Both the treatment and the control groups were analysed in a multi-factorial design using sex, age and class of instruction as independent variables. Students under fourteen and one half years of age were compared to the students above that age. Thus, younger students were compared to their older typewriting peers. Also, each class grouping was compared to each of the other classes in order to assure similarity of instruction in all classes.

Pretest scores were used as covariates to control for possible existing differences in typewriting ability at the beginning of the treatment. The average speed per minute for each of the 105 students participating in the study was obtained from two tests administered on February 26 and 27, 1981. Two separate pretesting occasions were used in case some students were absent at one or the other testing occasions. Where two test scores were available, the average of the two was used as the best estimator of typewriting speed and error rate. A few students attended only one of the two testing sessions. For these, their single score was used in the subsequent analysis of covariance. Similarily, the average error rate per minute

for each of the students who attended both of the pretesting sessions was calculated and used in all subsequent analyses of covariance which related to errors.

Potential differences in level of achievement at the beginning of the study were controlled by using analysis of covariance. For this purpose, the two pretest scores, S1 and S2, as well as E1 and E2, were averaged and used as covariates in analysing speed and error differences.

A three-factor analysis of covariance was performed to test for the effects of treatment, using age, sex, and class membership as independent factors.

Typewriting Speed

The hypothesis: There is no significant difference between the typewriting speed of students receiving four weeks of skill building instruction on microcomputers and the typewriting speed of students receiving four weeks of skill building instruction on electric typewriters as measured by straight copy tests was tested. Unadjusted speed means are presented in Table 4. F ratios for the analysis of variance of the adjusted treatment group speed means are given in Table 5. The differences on the mean posttest scores are not statistically significant. The findings fail to reject the null hypothesis.

Table 4

Mean Speed Per Minute Achieved by Group

Group	n	Pretest	S_3	S_4
Treatment	32	21.221	27.844	31.226
Control	73	20.845	28.361	31.085

Table 5

Analysis of Variance of the Treatment Group
On Terms of Speed Per Minute

Posttests	F	DF	Mean[2a]	Significance of F
S_3	0.491	1	8.271	0.485
S_4	0.046	1	0.875	0.831

a sum of squares identical

Typewriting Error Rate

The second hypothesis: There is no significant difference between the error rate scores of students receiving four weeks of skill building instruction on microcomputers and the error rate scores of students receiving four weeks of skill building instruction on electric typewriters as measured by straight copy tests was tested. Unadjusted error rate means are presented in Table 6. F ratios for the analysis of variance of adjusted error rate means of the treatment group are given in Table 7. The

differences on the mean posttest scores are not statistically significant. These findings fail to reject the null hypothesis.

Table 6

Mean Error Rate Per Minute Achieved By Group

Group	n	Pretest	E_3	E_4
Treatment	32	2.208	2.097	1.821
Control	73	2.301	1.610	1.457

Table 7

Analysis of Variance of Error Rate Per Minute On Treatment Group

Posttests	F	DF	Mean[2a]	Significance of F
E_3	3.570	1	5.189	0.062
E_4	2.617	1	2.503	0.109

[a] sum of squares identical

The Effect of Sex Upon Typewriting Speed

The following hypotheses were tested:

There is no significant difference between the typewriting speed of male students receiving four weeks of skill building instruction using

microcomputers and the typewriting speed of male students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

There is no significant difference between the typewriting speed of female students receiving four weeks of skill building instruction using microcomputers and the typewriting speed of female students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

The results of separating the groups by sex indicated that sex membership did not affect typewriting speed. Figure 1 demonstrates that both males and females in both the treatment and control groups had nearly identical learning curves, as measured by the pretest and posttest occasions. The exact means graphed in Figure 1 are given in Table 8. F ratios for the analysis of covariance of adjusted means are given in Table 9. The differences on the mean posttest scores are not statistically significant. The findings failed to reject both null hypotheses.

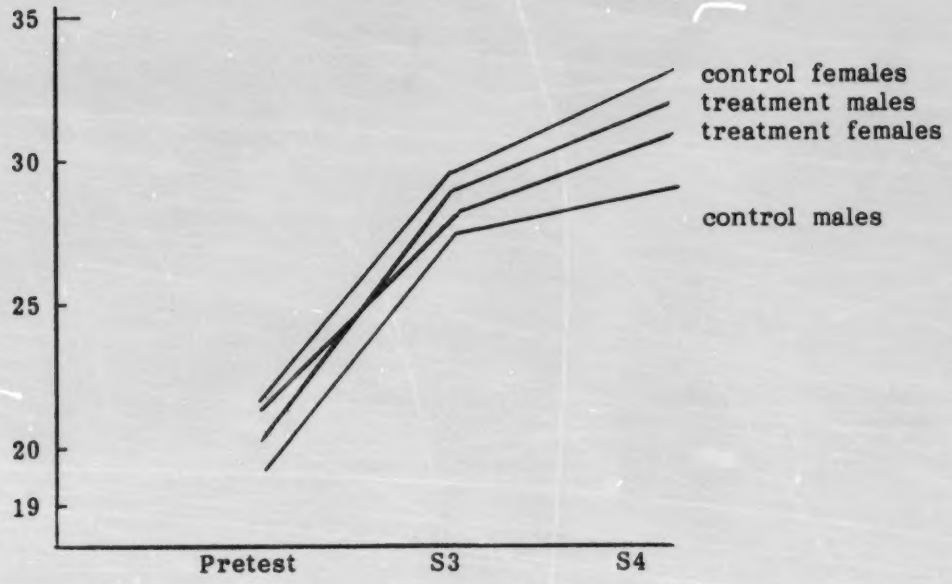

Figure 1. Speed performance in terms of means achieved by sex.

Table 8

Mean Speed Per Minute Achieved by Sex

Group	n	$\frac{S1+S2}{2}$	S3	S4
Treatment				
male	16	20.766	28.250	31.333
female	16	21.219	27.437	31.125
mean	32	20.993	27.844	31.229
Control				
male	25	19.620	26.833	28.958
female	48	21.422	29.125	32.170
mean	73	20.845	28.361	31.085

Table 9

Analysis of Covariance for Speed
Using Treatment and Sex

		F	DF	Mean[2a]	Significance of F
S_3	Treatment	0.386	1	6.561	0.536
	Sex	0.352	1	5.989	0.554
S_4	Treatment	0.001	1	0.006	0.986
	Sex	0.136	1	2.618	0.713

[a] sum of squares identical

The Effect of Sex Upon Typewriting Error Rate

The following hypotheses were tested:

There is no significant difference between the typewriting error rate of male students receiving four weeks of skill building instruction using microcomputers and the error rate scores of male students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

There is no significant difference between the typewriting error rate scores of female students receiving four weeks of skill building instruction using microcomputers and the error rate scores of female students receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

Error rate per minute in terms of means achieved by each sex is shown in Figure 2 and Table 10.

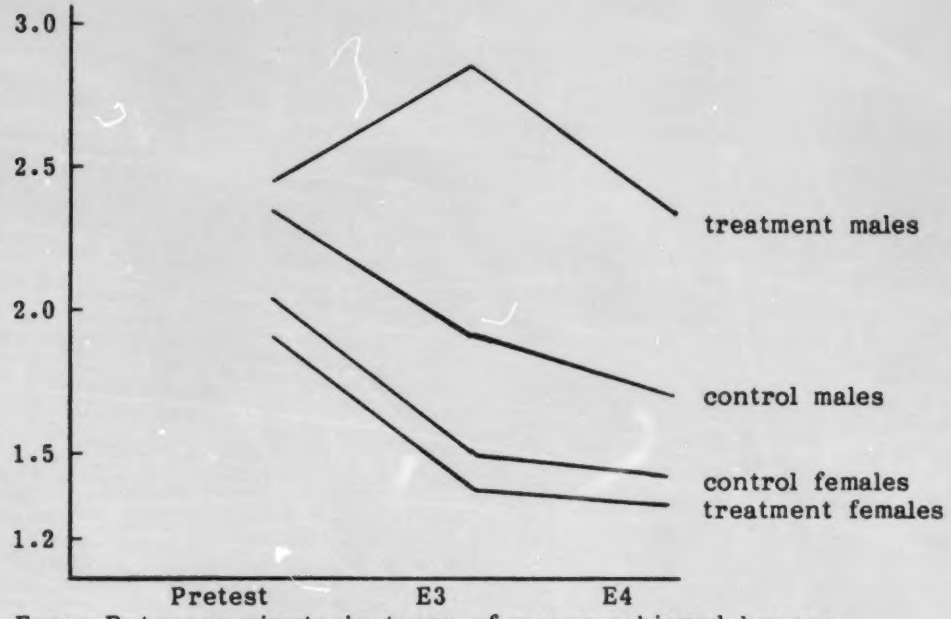

Figure 2. Error Rate per minute in terms of means achieved by sex.

Table 10

Means of Errors per Minute Achieved by Sex

Group	n	$\frac{E1+E2}{2}$	E3	E4
Treatment				
male	16	2.375	2.787	2.327
female	16	1.944	1.360	1.279
mean	32	2.137	2.074	1.803
Control				
male	25	2.330	1.929	1.679
female	48	2.026	1.447	1.341
mean	73	2.065	1.610	1.457

The data were organized according to treatment and sex and treated with the analysis of covariance, and illustrated in Table 11.

Table 11

Analysis of Covariance for Error Rate
Using Treatment and Sex

		F	DF	Mean[2a]	Significance of F
E_3	Treatment	2.566	1	3.389	0.112
	Sex	11.458	1	15.135	0.001
E_4	Treatment	1.861	1	1.650	0.176
	Sex	9.235	1	8.186	0.003

a sum of squares identical

The effect of sex upon the treatment group's error rate was significant at the $p < .01$ level on both posttesting occasions.

The findings rejected the null hypotheses. The results indicate that the males of the treament group did not achieve error rates as low as either the control group males or the females in the treatment group. In fact, their error rate increased from pretest to the first posttest time, then declined somewhat for the second posttest. Figure 3 illustrates the means of the male treatment group compared to those of the male control group.

While the control group showed the expected decrease in errors due to the practice effect, three of the four treatment sub-groups showed little improvement in error rate. The fourth group went from a very low pretest error rate to a nearly four-fold posttest error rate, then recovered somewhat on the second posttest.

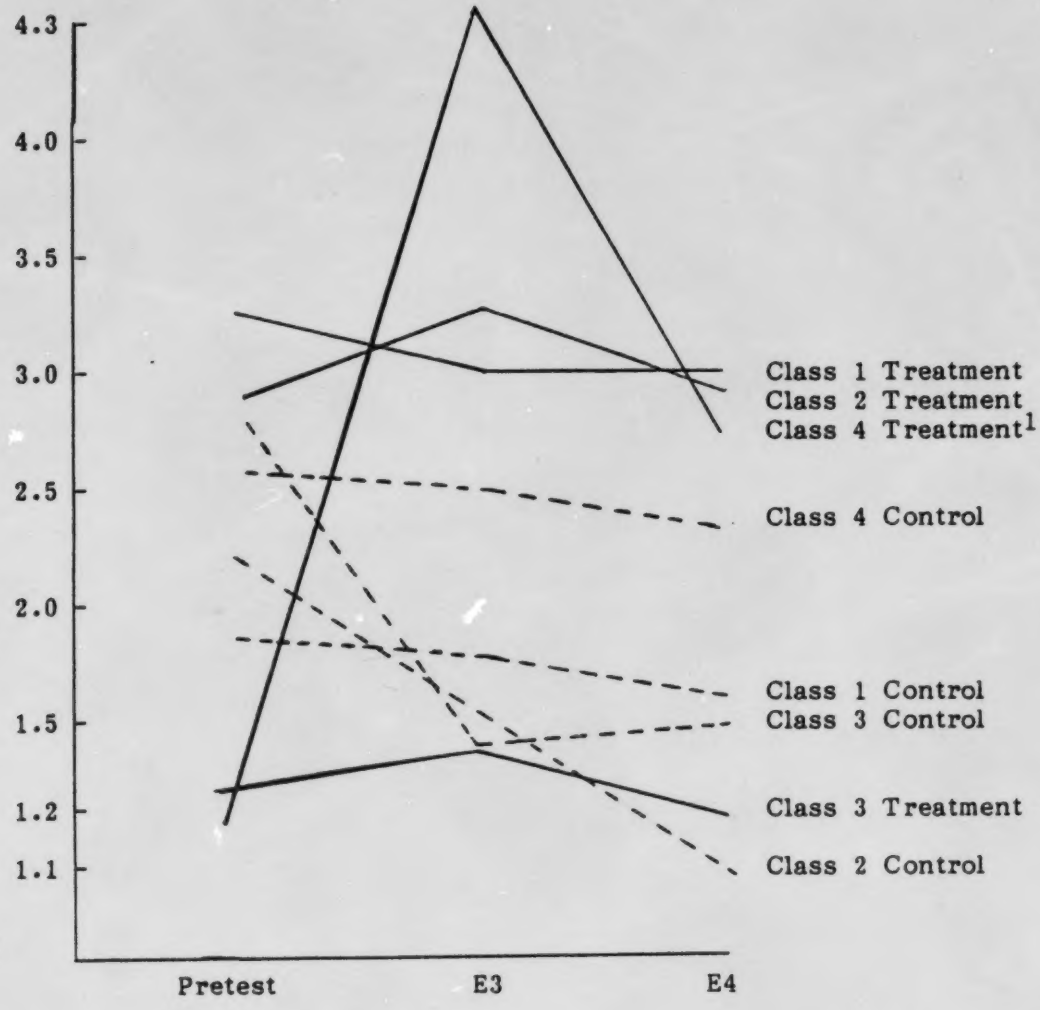

Figure 3. Male error means by class.

Note:

[1] Due to severe sample size

The Effect of Age Upon Typewriting Speed

The hypothesis, there is no significant difference between the typewriting speed of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using microcomputers and the typewriting speed of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests, was tested.

Unadjusted speed means for these students are presented in Table 12. F Ratios for the analysis of variance of adjusted means are given in Table 13. The differences on the mean posttest scores are not statistically significant. Thus the findings failed to reject the null hypotheses.

Table 12

Mean Speed Per Minute Achieved by Age

Years of Age	n	Pretest	S_3	S_4
Under 14.5	35	20.914	28.114	31.647
Over 14.5	70	20.836	28.246	30.868

Table 13

Analysis of Variance for Speed, Using Age

	F	DF	Mean[2a]	Significance of F
S_3	0.008	1	0.138	0.928
S_4	0.465	1	8.811	0.497

a sum of squares identical

The Effect of Age Upon Typewriting Error Rate

The eighth hypothesis was tested:

There is no significant difference between the typewriting error rate scores of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using microcomputers and the typewriting error rate scores of junior secondary students younger or older than fourteen and one half years of age receiving four weeks of skill building instruction using electric typewriters as measured by straight copy tests.

Unadjusted mean scores for error rates achieved are given in Table 14. F ratios for the analysis of variance of adjusted means are given in Table 15. The difference on the mean posttest scores are not statistically significant. The findings failed to reject the null hypothesis.

Table 14

Mean Error Rates Per Minute Achieved By Age

Years of Age	n	Pretest	E_3	E_4
Under 14.5	35	1.896	1.924	1.632
Over 14.5	70	2.261	1.675	1.528

Table 15

Analysis of Variance of the Treatment Group by Ages in Terms of Typewriting Errors Attained

	F	DF	Mean[2a]	Significance of F
E_3	1.868	1	2.762	0.175
E_4	0.737	1	0.719	0.393

[a] sum of squares identical

The Effect of Class Upon Typewriting Speed

The following hypothesis was tested:

There is no significant difference between the typewriting speed of students belonging to different classes as measured by straight copy test.

Unadjusted speed means of these students are given in Table 16. F ratios for the analysis of covariance of the adjusted means are give in Table 17. The differences on the mean posttest scores are not statistically significant. The study failed to reject the null hypotheses.

Table 16

Mean Speed Per Minute Achieved By Class

Class	n	Pretest	S_3	S_4
1	26	20.721	27.920	30.917
2	27	19.911	26.071	28.778
3	25	20.850	28.800	31.000
4	27	22.038	30.192	33.885

Table 17

Analysis of Covariance of Treatment Group by Class in Terms of Typewriting Speed Achieved

		F	Sum of Squares	Mean[2a]	DF	Signif. of F
S_3	Treatment	0.549	9.305	9.305	1	0.460
	Class	1.162	59.066	19.689	3	0.328
S_4	Treatment	0.093	1.765	1.765	1	0.761
	Class	1.577	90.085	30.028	3	0.200

The Effect of Class Upon Typewriting Error Rate

There is no significant difference between the typewriting error rate scores of students belonging to different classes as measured by straight copy tests, is the final testable hypothesis.

Unadjusted error rate means are given in Table 18. F ratios for the analysis of covariance for treatment and class are given in Table 19. The differences on the mean posttest scores are not statistically significant. Thus, the results fail to reject the null hypotheses.

Table 18

Mean Error Rates Per Minute Achieved By Class

Class	n	Pretest	E_3	E_4
1	26	2.138	1.952	1.775
2	27	1.973	1.621	1.512
3	25	1.900	1.396	1.225
4	27	2.548	2.092	1.731

Table 19

Analysis of Covariance for the Treatment Group by Class on the Error Rate of Typewriting

		F	DF	Sum of Squares	Mean[2a]	Signif. of F
E_3	Treatment	3.499	1	5.140	5.140	0.065
	Class	1.346	3	5.934	1.978	0.264
E_4	Treatment	2.675	1	2.575	2.575	0.105
	Class	1.618	3	4.671	1.557	0.191

V. SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

An experimental study was conducted with beginning typewriting students to investigate the effect of the microcomputer upon the students' speed and accuracy at the conclusion of a four week skill building period. The study compared the differences in the two skill components of speed and level of accuracy between students who practiced using a microcomputer and those who practiced using an electric typewriter. The study specifically addressed two questions:

1. Is the microcomputer as effective a classroom instructional tool as an electric typewriter when conventional skill building, teacher-directed, techniques are used?

2. Is the equipment which was selected for the study suitable for teaching introductory typing when conventional accepted teaching methods are used?

The non-equivalent control group design (Campbell & Stanley, 1963, pp. 47 - 50), modified to include aspects of a time series design (Campbell & Stanley, 1963, pp. 55 - 57) was used. One hundred and five typing students in a large Vancouver secondary school were randomly assigned to experimental and control groups.

The treatment group was instructed in beginning typewriting on Commodore PET microcomputers having 40 character lines of print on a video display terminal, while the control group received simultaneous instruction on IBM electric typewriters in the same room. Both the control group and the treatment group were treated as a unit classroom, receiving the same typewriting instructions.

The four week treatment program on the microcomputer gave speed and accuracy component drills through the operation of a stored program on the tape; these drills were identical to the printed materials used by the control group. Skill building exercises were displayed on the video terminal. The treatment group followed pre-programmed instructions, typing responses in the same fashion as the control group. The control group was taught the basic skills in the traditional manner following the identical sequences as the treatment group.

The pretests consisted of two, two minute timed writings from straight copy material selected from typical instructional sources and measured typewriting speed and accuracy. The posttests consisted of similar straight copy material. Two posttests were administered one week apart to assess recovery from the treatment.

Findings

The results of the study failed to reject the null hypotheses regarding treatment and control groups. The treatment students learned as well on

the microcomputers as the control students learned on the electric typewriters.

The findings regarding the suitability of the hardware available for this study are primarily resulting from observations of the author, participating teachers and the students from the experimental group. It should be mentioned that of several retailers who were approached for leasing their equipment for this study, only one firm, Conti Electronics, agreed to participate. Thus, while the impressions presented here may not be complimentary for the Commodore machines, this is not to say that other products do not suffer from the same or greater shortcomings.

One compliment which Commodore deserves is that they were willing to expose their equipment to this study while the other manufacturers were not.

The results showed that the Commodore machines are as effective as electric typewriters, while the effectiveness of other machines remains to be demonstrated.

A disadvantage of the machines used here was the short line length of 40 characters. This necessitated truncation of the original practice lines which were 60 characters in length. Since the execution of this study in March, 1981, new machines featuring an 80 character line have been designed by Commodore and others.

As most typewriting exercises had to be stored for accurate comparisons, the 32,000 character memory bank was adequate. Some of the leased machines featured only 16,000 characters of memory storage. This was not enough.

Since the layout of the microcomputer keyboard should be similar to the IBM electric typewriter used by the control group, and the entire project group for pretests and posttests, several keys on the microcomputers had to be reprogrammed to conform to this design. This used additional memory space.

The RUN/STOP key was too close to the RETURN key. To avoid accidental depression of the RUN/STOP key, the key was purposely disabled. This had the side effect of disabling the internal time clock as well, and less accurate methods of timing had to be programmed.

Loading the program from a cassette tape - even though very inexpensive - proved too slow. It took 4 1/2 minutes, nearly 10 percent of the available class time during each class period, to load the program.

On the positive side, there were some appealing characteristics. The screen appeared to be at an optimal distance, was easy to read, and bright enough in this well lighted classroom. The flicker-free, green upper and lower case letters seem less tiring than white letters on a black screen.

The keyboard height was the same as the typewriters.

Having all components in a single housing with a minimum of cables appeared advantageous in a school setting.

Equipment breakdown was confined to one tape unit during the four week period. This was certainly a good showing as the machines were left on during the entire study, nights and weekends included.

Students tended to object to the very light touch of the microcomputer keyboard, especially since this caused their initial error rate to jump substantially. It is more difficult to anchor one's fingers on this keyboard; the slightest depression registers as a stroke. Many of student comments on the questionnaire concerned the touch. For example, the comments of, "It was difficult to get used to the light touch of the computer"; "... that typing on a computer was hard because you had to have a light touch"; "If you press your fingers too hard or too springy you would have typed double letters"; "...sometimes I wouldn't press a certain letter, but it would show up on the screen"; "the keys are sensitive"; "it takes a while to develop the right touch for the keys"; "you must be very light fingered", suggest a level of user frustration.

Several students were troubled by the absence of a typing sound or clicking noise which, on a typewriter, indicates a key stroke. This could be related to the lighter touch however.

Teacher comments were positive and tended to center on mechanical operations. The teachers were enthusiastic about the features of high

teacher flexibility, direct teacher input allowing them to program their comments directly into the memory banks of the computer, and the increase in possible motivational level of their students.

Conclusions

1. The microcomputer is as effective as an electric typewriter to teach the typewriting skill component of speed regardless of the age, sex, or class to which the student is assigned.

2. The microcomputer is an effective means to teach the typewriting skill component of accuracy regardless of age or class to which the student is assigned.

3. The microcomputer used in this study may be less effective than the electric typewriter in teaching accuracy for males than for females. However, this result appeared in only one of the four classes and may have been a consequence of the small male number of students in that treatment group, (only two males).

Recommendations

Typewriting

1. The microcomputer be used as a viable alternative to the electric typewriter in teaching skill components of speed and accuracy.

2. The use of microcomputers be expanded in introductory typewriting.

3. Teachers of introductory typewriting courses be encouraged to attend training sessions on the programming and the operation of microcomputers.

4. Student score keeping programs for monitoring their progress in introductory typewriting classes be prepared.

Hardware

1. Microcomputers used in typewriting programs should have a 32,000 character memory.

2. Microcomputers used in typewriting programs should have an 80 character line length.

3. Microcomputers used in typewriting programs should have a keyboard design similar to an IBM electric typewriter.

4. Microcomputers used in typewriting programs should have a disk or ROM storage feature for faster loading.

5. Microcomputers used in typewriting programs should be in one housing, with a minimum of cables and installed at the appropriate desk top height.

6. Microcomputers used in typewriting programs should have a keyboard touch sensitivity similar to an electric typewriter.

Software

1. Microcomputers used in typewriting programs need further software development.

2. BASIC is a viable programming language for typewriting program development.

Areas of Further Research

1. Typewriting tasks of centering, letters and general production typewriting be investigated for their possible programability on the microcomputer.

2. Typewriting nemesis of student strike-overs and screen/paper watching be investigated and assessed for microcomputer applicability.

3. The cost features of replacing electric typewriters with microcomputers be investigated. While it may not be economically feasible for a school which fully utilizes a typing laboratory to replace their electric typewriters with microcomputers, it may, on the other hand, make economic sense for a school with only one class of typewriting per day to equip a laboratory with microprocessors. Other subject fields, such as mathematics and science may require cost effective equipment for their computer science courses, thus saving the costs of supplying typewriters as well.

4. Administrative tasks such as pupil attendance monitoring, purchasing, inventory and budgeting, be assessed for their compatibility with instructional programs.

5. The implications of a non-specialist teacher in using the microcomputer in the typewriting classroom and the resulting in-service training needs required should be investigated.

6. As microcomputers with additional features become commercially available, their suitability in the typewriting classroom should be assessed.

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APPENDICES

APPENDIX A.
STUDENT QUESTIONNAIRE March 31, 1981 male_____female _____

STUDENT RESPONSES

1. Which of the following practice modes did you find the easiest to use? (please check one)

Mode 1 (pre-test, practise, post-test)	_____	7
Mode 2 (single line practise)	_____	7
Mode 3 (open, warm-up practise)	_____	18

2. Which of the following practice modes did you find that you learned the most from?

Mode 1	_____	22
Mode 2	_____	10
Mode 3	_____	0

3. Which of the following practice modes did you enjoy using the most?

Mode 1	_____	17
Mode 2	_____	7
Mode 3	_____	8

4. Which of the following practice modes did you experience the greatest difficulty in?

Mode 1	_____	17
Mode 2	_____	11
Mode 3	_____	4

5. Which of the following practice modes did you enjoy the least?

Mode 1	_____	8
Mode 2	_____	15
Mode 3	_____	9

6. In which of the following practice modes did you learn the least from?

Mode 1	_____	5
Mode 2	_____	7
Mode 3	_____	20

7. Do you feel that the computer program helped you increase your speed?

(circle one) 1. yes 2. don't know 3. no 14 10 8

8. Do you feel that the computer program helped you increase your accuracy?

(circle one) 1. yes 2. don't know 3. no 13 7 12

STUDENT RESPONSES

9. Did you feel tired after a period of typing on the computer?

(circle one) 1. yes 2. don't know 3. no **4 3 25**

10. Did you feel that watching the screen for one period was tiring for your eyes?

(circle one) 1. yes 2. don't know 3. no **4 2 27**

11. Would you like to do another typing computer program?

(circle one) 1. yes 2. don't know 3. no **19 8 5**

males **12 3 1**
females **7 5 4**

12. Did you talk about the computer program with:

1. your friends	yes	no	**15 5**
2. your parents	yes	no	**17 3**
3. your teachers	yes	no	**1 1**
4. others	yes	no	**2 3**

13. About how long did it take you to get used to using the computer? (circle one)

DAYS: **5 days**
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 more than 15

14. About how long did it take you to feel comfortable about using the computer (circle one)

DAYS: **5 days**
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 more than 15

15. Did you ever work with a computer before?

1. in the school?	yes	no	**6 26**
2. at home?	yes	no	**5 26**

16. How far in the skill-building program did you get?

page number 10 group no. 4

17. In your opinion, did the students on the electric typewriters type essentially the same material that you did?

(circle one) 1. yes 2. don't know 3. no **24 4 1**

18. How much of the typing period did you spend on the computer? (please check one)

STUDENT RESPONSES

18. (cont'd)

full period (60 min.)	13
(50 min.-59 min.)	8
(40 min.-49 min.)	9
(30 min.-39 min.)	2
(16 min.-29 min.)	0
(less than 15 min.)	0

19. What speed did you usually achieve while using the computer? (Gross Words Per Minute; GWPM) (circle one)

RESPONSE:	**2**	**5**	**9**	**8**	**4**	**1**	**2**
	0-15	16-20	21-25	26-30	31-35	36-40	41 or more

20. About how many errors did you normally make per minute while using the computer? (circle one)

RESPONSE:	**0**	**0**	**5**	**11**	**5**	**4**	**2**	**5**
	zero	one	two	three	four	five	six	seven or more

21. Generally, if you were to describe the program it would be: (circle one on each line)

RESPONSE:	**1**	**21**	**8**	**2**	
a)	very useful	useful	not really useful	useless	
	1	**0**	**6**	**16**	**9**
b)	very boring	boring	uncertain	interesting	very interesting
	2	**19**	**10**	**1**	
c)	very easy	easy	difficult	very difficult	

22. General Comments: Would you like to tell me anything else about this computer program? Please comment below.

APPENDIX B. STUDENT DIRECTIONS

A. TO LOAD YOUR PROGRAM:

1. Check plugs: (a) Tape Drive to Computer
   (b) Computer to Power Source

2. Turn on Computer (Switch at back on Left Side) A Message will appear on the screen. "###COMMODORE BASIC### ...READY." Also the CURSOR will be FLASHING

3. Insert the program tape cassette into the Tape Drive. Make certain that the cassette is rewound!

4. TYPE LOAD on the Computer Keyboard and then PRESS the RETURN Key. (If you make a spelling mistake use the INST/DEL Key to backspace; and retype the correct spelling). At this point the message on the screen should be "PRESS PLAY ON TAPE # 1".

5. PRESS the PLAY button on the Tape Drive. (DO NOT TOUCH THE KEYBOARD UNTIL THE "READY" MESSAGE with the Flashing CURSOR appears.) This message takes about 4-5 minutes to appear.

6. When you see the message PRESS the STOP/EJECT button on the Tape Drive. PRESS the REW (rewind) button on the Tape Drive to rewind the cassette for future use.

7. PRESS the STOP/EJECT button on the Tape Drive when the cassette is rewound.

CONGRATULATIONS YOUR PROGRAM IS READY

B. TO RUN YOUR PROGRAM:

1. TYPE "RUN" on the Computer Keyboard and PRESS the RETURN Key.

2. Select a sub-program from a MENU of 4 Programs by PRESSING a number (either 1,2,3 or 4) on the small number keyboard on the right side of the Computer console.

3. Follow directions on the Computer's Screen. The "@" key will temporarily halt a program.

NB: IF the Computer EVER gives the "READY" message with the flashing CURSOR then TYPE RUN and PRESS the RETURN Key. NEVER TYPE IN NUMBERS AT THIS TIME!

BEST WISHES AND GOOD LUCK.

APPENDIX C. TEACHER INFORMATION

A. INTRODUCTION OF COMPUTER EXPERIMENT TO THE CLASS:

(generally about 2-3 minutes in length and very low key approach)

1. "We are doing an exercise for Business Education teachers who wish to find out how useful computers might be in a typewriting classroom. They are expensive and thus we can't buy them until we see if they are worthwhile."

2. "We drew some names from a hat to see who will work on them during the 4 weeks they will be here. That is why some of you can operate them and others can not. Perhaps at some future time the rest of you will get a try."

3. Read out the 8 names.

B. SPECIAL FEATURES:

1. Use the INST/DEL Key as a backspacer. This is best in Mode 3, the "Free Mode". When the INST/DEL Key is used in Mode 1, there is a SHAKEY, back and forth motion to the print on the line which was backspaced.

2. It is very important for the students to match EXACTLY the letters and blanks DIRECTLY beneath the coded line on the screen. To do otherwise will result in a series of errors.

3. TYPING POWER DRILLS:

Letter	Page		Page	Group
a	15	is	11	1 & 2
d	16	is	11	3 & 4
f	16	is	12	1 & 2
j	18	is	12	3 & 4
k	18	is	13	1 & 2
l	18	is	13	3 & 4
s	21	is	14	1 & 2
y	23	is	14	3 & 4

4. The reinforcement message in Mode 1 is based upon the 1st try post-test. There is a general reinforcement message in Modes 2 and 3 which can also be altered at your direction.

5. All Modes are fully operational; in Mode 2 the timing length for each single repeated line is to be set by the teacher. During the pilot study no student used up all of the available screen during a 2 minute timed series. There are 9 visible lines in this mode.

6. In Mode 1 during the "practice" section; this can be done at the student's leisure; BUT they must wait for you to start them on the post-test. Also if they pick the wrong drill, they may PRESS the "@" Key twice to return to the Menu. Caution: there is a noticeable pause after the 1st key, WAIT for it.

APPENDIX D. SOFTWARE PROGRAM

```
190   o$=")_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)_)"
195   o1$="========================================"
200   dima$(8),c$(4),e(3,4),t1(3,4),t$(3,4):poke59468,14:goto8000
240   print"SKILL BUILDING DRILLS"
243   print o$
250   print"WHERE DO YOU WANT TO BEGIN?
251   print"(Use RETURN-key after numbers.)
261   input"   PAGE=   ";p:input"   GROUP=   ";g
281   input"NUMBER OF TRIES=   ";n
290   ifn=>thenn=4
295   r=(p-1)*16+(g-1)*4+1:gosub1360
320   gosub1210:forx1=1to3:g1=0:ifx1=2theng1=1
360   forx2-1ton:gosub610:j1=0:t3=0:gosub710:gosub810:t=s3/52:gosub1010
410   nextx2:nextx1:Gosub1030
450   fors1=1to3:fors2=1to4
460   t1(s1,s2)=0:t$(s1,s2)="":e(s1,s2)=0
470   nexts2:nexts1:goto320
610   print"   PRESS '-KEY AT TIMING BELL
630   printo1$
640   print"Page"p", Group"g+g1
650   print"********PRESS SPACE BAR TO BEGIN********
660   ifpeek(144)=88thenpoke144,85:ifpeek(144)=49thenpoke144,46
661   fory=1to999999:getx$:ifx$=""then run
662   ifx$=" "then690
663   nexty
690   return
710   print"":printa$(g1*4+1)
720   print""a$(g1*4+2)
730   print""a$(g1*4+3)
740   print""a$(g1*4+4)
750   print""o1$
760   return
810   ifpeek(144)+85thenpoke144,88:ifpeek(144)+46thenpoke144,49
811   s3=0:fors1=1to4:gosub950:print"$":p$="":fors2=1to40
815   getx$:s3=s3+1:ifx$=""then815
816   ifx$=chr$(13)then825
817   ifx$=""thenc$(s1)=p$:goto830
820   gosub1320:p$=p$+x$:gosub950:printp$+"$":nexts2
825   gosub950:printp$+" ":c$(s1)=p$:nexts1:ifs1>4thens1=4
830   ifpeek(144)=88thenpoke144,85:ifpeek(144)=49thenpoke144,46
831   e1=0:e2=0
835   forx3=1tos1:e3=0:y=x3+g1*4:1=len(c$(x3))
855   if1<2thens3=0:return
860   forz=1to1
865   ifmid$(a$(y),z,1)<>mid$(c$(x3),z,1)thene3=e3+1
866   nextz
868   ife3=0the[illegible]=e1+1
869   e2=e2+e3:nextx3:return
900   z=int(z*100+.5)/100:z$=str$(z)
910   ifz=int(z)thenz$=z$+".00":return
920   ifmid$(z$,len(z$)-1,1)="."thenz$=$+"0"
930   return
```

```
950   q$=""
955   q1$=left$(q$,6+3*s1):printq1$:return
1010  t5=0
1011  fork=1to4:t5=t5+len(c$(k)):nextk
1013  ifg1=0and t5>4andt<>0thent1(x1,x2)=(t5/5)/(t/60)
1015  e(x1,x2)=e2
1020  ifg1<>0thent1(x1,x2)=e1
1025  return
1030  print""
1032  print"YOUR RESULTS FOR: PAGE";p;", GROUP";g;"and";g+1
1034  printo1$
1035  printtab(12);"1.try   2.try   3.try"
1040  print:fors1=1to3step2
1050  fors2=1ton
1060  t1(s1,s2)=int(t1(s1,s2)+.5)
1070  nexts2:nexts1
1080  print"Pre-test :";e(1,1);"/";t1(1,1);
1081  printtab(21);e(1,2)"/"t1(1,2)tab(30)e(1,3)"/"t1(1,3)
1090  print"Practice : "t1(2,1)tab(21)t1(2,2)tab(30)t1(2,3)
1100  print"Post-test: "e(3,1)"/"t1(3,1)tab(21)e(3,2)"/"t1(3,2);
1104  printtab(30);e(3,3);"/";t1(3,3)
1106  print""o1$
1110  print"Record your results, then press
1112  print"spacebar to go on or '-key for menu.
1115  gosub1400:gosub660:return
1210  forx4=1to8:reada$(x4):nextx4
1215  print(r/16)+1:g=((r-1)-(p-1)*16)/4+1:r=r+8
1220  return
1320  ifx$=";"thenx$=".
1321  ifx$="!"thenx$="1
1322  ifx$=chr$(34)thenx$="2
1323  ifx$="#"thenx$="3
1324  ifx$="$"thenx$="4
1325  ifx$=":"thenx$=";
1326  ifx$="%"thenx$="5
1327  ifx$=""thenx$="6
1328  ifx$="&"thenx$="7
1329  ifx$=" "thenx$="8
1330  ifx$="("thenx$="9
1331  ifx$=")"thenx$="0
1332  ifx$=chr$(162)thenx$-chr$(34)
1333  ifx$=chr$(186)thenx$-chr$(58)
1334  ifx$=chr$(220)thenx$-chr$(42)
1335  ifx$="?"thenx$="/
1336  ifx$="?"thenx$="?
1337  ifx$="("thenx$="(
1338  ifx$=")"thenx$=")
1339  ifx$="!"thenx$="!
1340  ifx$="#"thenx$="#
1341  ifx$="$"thenx$="$
1342  ifx$="%"thenx$="%
1343  ifx$="&"thenx$="&
1344  ifx$=""thenx$="
```

```
1345  ifx$=";"thenx$=";
1346  ifx$=","thenx$=",
1347  return
1360  ford2=1tor:readd$:nextd2:return
1400  u=t1(3,1):v=e(3,1)
1405  print""o$""
1409  ifu<10thenprint"EXTRA PRACTICE NECESSARY"
1410  ifu>9andu<14andv<4thenprint"THAT'S BETTER NOW GO FOR SPEED!!"
1420  ifu>9andu<14andv>3thenprint"EXTRA PRACTICE NEEDED"
1440  ifu>13andu<17andv>4thenprint"CONCENTRATION REDUCES ERRORS"
1450  ifu>16andu<20andv<4thenprint"NOW YOU'RE ROLLING!!!"
1460  ifu>16andu<20andv"3thenprint"THOSE ERRORS ARE COSTLY!!"
1470  ifu>19andu<25andv<4thenprint"NICELY DONE!!"
1480  ifu>19andu<25andv>3thenprint"WARNING-ERRORS ARE HAZARDOUS"
1490  ifu>24andu<30andv<4thenprint"YOU ARE STARTING TO IMPRESS"
1500  ifu>24andu<30andv>3thenprint"GETTING TOO OVER-CONFIDENT"
1510  ifu>29andu<36andv<4thenprint"NOBODY'S   PERFECT-BUT   YOUR'RE
      CLOSE"
1511  ifu>29andu<36andv>3thenprint"YOU'RE IN HIGH GEAR"
1512  ifu>35andu<41andv<4thenprint"EVER THOUGHT OF TURNING PRO?"
1513  ifu>35andu<41andv>3thenprint"FAST, BUT NOT FANCY"
1514  ifu>40andv<4thenprint"YOU'RE HIRED!!!"
1515  ifu>40andv>3thenprint"FAST, BUT IS IT ENGLISH?"
1521  print""o$
1530  return
1999  data"this is a non-printed line"
2000  datea"I did. I did. I do. I do. I did"
2010  data"it.  I did it. It is I."
2020  data"It is I.  It is I. It is a doll."
2030  data"It is old.  I said so."
2040  data"ik ik ik if if is is if if is is ik ik"
2050  data"kid kid lid lid dill did did aid a"
2060  data"skill skill slid slid slid lid li"
2070  data"disks disks disks sail sail ill if"
2080  data"Joe had a fall.  He hurt his foot."
2090  data"His dad asked Dr. Good to look"
3000  data"at the foot.  The chocolate"
3010  data"cake looks good to me."
3015  data"ol ol ol do do do so so so lo lo lo do"
3020  data"old old old aid aid aid ado ado ado old"
3015  data"fold fold fold sold sold sold load load"
3030  data"all aid all loads so all is sold all of"
3035  data"Nothing is done right.  I think"
3040  data"there is a loss.  Ask John."
3045  data"I shall thank John.  Joe thinks"
3050  data"the note is due.  Now go."
3055  data"tf tf to to it it at at it it to to at"
3060  data"tot tot tot jot jot jot too too too dot"
3065  data"sat sat fat fat kit kit kit kit tot tot too"
3070  data"told told told total total total told"
3075  data"He has the last old desk.  Let Jill"
3080  data"see the total.  Run now."
3085  data"Joe feeds the seals.  He has the lead."
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3090  data"I sold it.  I see it."
3095  data"hf hf hf ha ha ha hf hf hf ho ho ho hi"
4000  data"had had had hat hat hat hit hit has has"
4001  data"aha aha aha ash ash ash had had had has"
4002  data"dish dish dish hall hall hall hill hill"
4005  data"Jill is here; Jeff said she is."
4006  data"He has a red rug.  He went."
4007  data"Gus feeds a red deer.  Dr. Hall"
4008  data"sued Jake Lee.  He sees you."
4010  data"ed ed eh eh edit edit edit elf elf elk"
4011  data"led led let let fed fed jet jet lee fee"
4012  data"see see tee tee fed fed tea tea jet jet"
4013  data"sea sea led led heed heed lead lead dee"
4015  data"The food is so old.  The lease is"
4016  data"out at the lake.  Go out."
4017  data"He used it all.  She used it all."
4018  data"It is a duet.  Use it all."
4020  data"uj uj uj us us us use use use used used"
4021  data"out out out due due due use use use sue"
4022  data"Hal is out.  Hal is out.  He is out.  He"
4023  data"It is due.  It is due.  Use it all.  Use"
4025  data"It is good glue.  The glue held."
4026  data"Jill is good.  Go now."
4027  data"Joe is good.  he told a joke."
4028  data"The glass is hot.  Good."
4030  data"gf gf gf go go go got got got get get"
4031  data"keg keg glad glad glad good good go"
4032  data"gas gas gas egg egg egg glue glue ego"
4033  data"tugs tugs tugs ages ages ages eagle ego"
4035  data"The girl tried to read the joke."
4036  data"The glass fell.  Ask Ruth."
4037  data"The road to the lake has ruts."
4038  data"He told it to all.  Run ask."
4040  data"rf rf rf rod rod rod rid rid rid ride"
4041  data"ore ore ore for for for fair fair fair"
4042  data"real real real rate rate rate order ode"
4043  data"after after after relate relate relate"
4045  data"He can read the old letter.  It"
4046  data"is fun to read it.  Read it."
4047  data"Cancel all the old contracts."
4048  data"Run to the house.  I can go."
4050  data"njh nj nj an an an and and and no no no"
4051  data"fern fern tone tone tone than than in"
4052  data"thank thank thank think think inner inn"
4053  data"He hit the nail.  He hit the nail hard."
4055  data"Carl had a fall; he hurt his right"
4056  data"leg.  Try to do so soon."
4057  data"Let us make sure that there is some"
4058  data"ice cream for us to eat."
4060  data"cd cd cd cod cod cod code code code cod"
4061  data"can can cane cane critic critic cling"
4062  data"since since since office office color"
4063  data"enclose enclose credit credit chart"
```

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4065  data"The new way is not said to be"
4066  data"better, but certainly easier."
4067  data"A blue ribbon was used to tie the"
4068  data"big parcel for her party."
4070  data"p; p; p; pep pep pet pet put pa"
4071  data"pass pass pad pad pad cap cap cap pick"
4072  data"up up up upper upper supper supper up"
4073  data"lip lip lip tip tip sip sip top top top"
4075  data"The water was cold.  he will sail"
4076  data"on the water. Walk on now."
4077  data"We hope Pat will win the race."
4078  data"Follow a recipe.  Thank you."
4080  data"ws ws ws who who what what when when ws"
4081  data"wit wit walk walk walk will will was wa"
4082  data"wet wet wet wheat wheat wheat week week"
4083  data"wink wink were were were was was saw so"
4085  data"Pam p  hased a trumpet. Norm"
4086  data"wrote memoranda. Make a cake."
4087  data"Jim went to the market to get"
4088  data"some meat and eggs yesterday."
4090  data"mj mj mj me me me mad mad mad made made"
4091  data"home home home foam foam foam some some"
4092  data"sum sum sum from from from much much mo"
4093  data"palm palm palm poem poem poem slump man"
4095  data"The quick question made him stop."
4096  data"He almost quit smoking."
4097  data"Ken enquired if he had a quarter"
4098  data"section. He has to go now."
4100  data"qa qa qa quit quit quit quote quote qui"
4101  data"pique pique pique aqua aqua enquire qaq"
4102  data"acquire acquire acquire acquit acquit"
4103  data"quest question question quota quota qui"
4105  data"Please open the oven. The liver"
4106  data"is on fire. Stop the smoke."
4107  data"The review was helpful. It was"
4108  data"done with vim. Very nice."
4150  data"vf vf vf fie vie vie van van vital vita"
4151  data"solve solve oven oven vigor vigor vim"
4152  data"visa visa visa viper viper viper vice"
4153  data"via via via wives wives lives lives way"
4160  data"It is part of his duty to help those"
4161  data"in need. He is loyal."
4162  data"Every voter should demand a"
4163  data"statement of policy each year."
4170  data"yj yj yj yell yell yellow yellow yes ya"
4171  data"my my you you your your any any day day"
4172  data"yard yard yard year year year yet yet y"
4173  data"your your youth youth they they they ya"
4180  data"She will be busy planning the"
4181  data"breakfast or brunch tomorrow."
4182  data"He feels much better because he"
4183  data"knows he did a good job."
4190  data"bf bf bf buff buff bus bus bull bo"
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4191  data"ball ball ball but but but but by by by buy"
4192  data"balance balance balance back back bit b"
4193  data"bank bank bank tub tub tub stub stub be"
4200  data"The chocolate cake looks good, Joe"
4201  data"said to Chris as she cut it."
4202  data"He likes food. Jack told us to"
4203  data"go out to see Carl run."
4210  data",k ,k ,k one, two, three, four; one, ,k"
4211  data"Frank, John, and Alec will go. Well, I"
4212  data"When I get it, I will pass it on to him"
4213  data"John left his home town of Orillia, ON."
4220  data"It changes the typing of letters"
4221  data"to a new exciting exercise."
4222  data"If you have been lax in recent"
4223  data"years, try to be early now."
4230  data"xs xs xs ox ox ox fox fox box box tax x"
4231  data"express express extra extra six six six"
4232  data"expire expire expell expell expell axe"
4233  data"exact exact exact executive executive"
4240  data"Zeke was amazed at the size of"
4241  data"the dozen zebras in the zoo."
4242  data"Zo was amazed and dazzled by the"
4243  data"size of the puzzle prizes."
4250  data"za za za zone zone zoo zoo zoo zero zoo"
4251  data"prize prize zoom zoom ozone ozone zeal"
4252  data"Voting is not the only duty of citizens"
4253  data"One should minimize the chance of loss."
4350  data"Many a lanky lad may have a"
4351  data"mania for eating banana salads."
4352  data"Alan may appeal to Havana again"
4353  data"and ask for Almas release."
4360  data"aaa aid aaa all aaa alas aaa apart aaa"
4361  data"area data aqua saga away gala papa aria"
4362  data"alarm awake again arena amaze mania aaa"
4363  data"adage adapt madam camera animal ballad"
4370  data"Ed does good deeds daily and"
4371  data"draws due rewards by doing so."
4372  data"Dude dreads doing any odd jobs"
4373  data"but he did dye dads ladder."
4380  data"ddd did ddd dye ddd dude ddd dried ddd"
4381  data"died deed odds dyed duds dead adds idea"
4382  data"dozed dodge dread dandy faded aided end"
4383  data"toddy caddy added middle ladder adding"
4390  data"An office staff often finds"
4391  data"officials favoring free coffee."
4392  data"Cliff offered Duffy a fifth"
4393  data"of his staff for the five days."
4400  data"fff for fff off fff buff fff fifth ffff"
4401  data"biff doff tiff tuff cuff fife safe left"
4402  data"stuff bluff staff affix stiff taffy fff"
4403  data"fluff muffs offer office differ suffer"
4410  data"James objected to joining Joe"
4411  data"and John on a jaunt to Japan"
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4412  data"Judge Jensen, the juvenile judge,"
4413  data"is just and enjoys jokes."
4420  data"jj job jjj joy jjj just jjj major jjj"
4421  data"jobs jugs join ajar jury joys jade jail"
4422  data"joint jelly judge jolly enjoy joker joy"
4423  data"jumbo juster jurors unjust adjourn jour"
4430  data"Ken knew Ike like cake and"
4431  data"asked Kay to bake it this week."
4432  data"Kaye and Karen would like to"
4433  data"pick up silky kapok in Keokuk."
4440  data"Life will look small unless"
4441  data"all laughs lead to fulfillment."
4442  data"Lucille will allot twenty dollars."
4443  data"to allow for legal bills."
4450  data"lll lay lll all lll will lll level lll"
4451  da  lull lilt loll lily fell bill sell mill"
4452  da a"alley local lilac legal label libel low"
4453  data"wills rolls shall knolls balled billed"
4460  data"Susan says she is sure she"
4461  data"passed an easy test last summer."
4462  data"Yes, our losses from the sale."
4463  data"of stocks and suits seem less."
4470  data"sss sue sws sis sws loss sws sales swsw"
4471  data"loss less sues used sits sash sees sirs"
4472  data"sales socks loses slash sense suits sis"
4473  data"issue stress bosses assets assists sue"
4480  data"eEvery entry in Addys diary"
4481  data"displayed loyalty to your city."
4482  data"Mayor Younger yearns to study"
4483  data"about pyramids while a Yale."
4490  data"yyy you jyj yet jyj year jyj yearn jyj"
4491  data"yawn your type many days yard duly city"
4492  data"youth dryly shyly slyly mayor study yet"
4493  data"windy mayfly typing yearly pyramid try"
4500  data"1",data"2",data"3",data"4"
8000  print" SELECT ONE CHOICE FROM THIS MENU:
8010  print"  1.Skill Building Drills"
8015  print
8020  print"  2.Single Line Practice"
8021  print
8030  print"  3.Self-directed Warmups, Timings  & Carriage Returns"
8035  print"  4.FINISH"
8040  print"Your choice:";
8045  getkl$:if kl$=""then8045
8050  kl-val(kl$):onklgoto240,8500,9000,8080
8060  Print"Return only 1 or 2 or 3 or 4."
8070  goto8040
8080  ifpeek(144)=88thenpoke144,85:ifpeek(144)=49thenpoke144,46
8081  print"":end
8500  print"  SINGLE LINE PRACTICE"
8502  printo$
8505  input"  Page:  ";p
8510  input"  Group: ";g
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8530  input"  Line#: ";l
8540  r=(p-1)*16+(g-1)*4+1+1:gosubl360
8620  openl,o:ifpeek(144)=85thenpokel44,88:ifpeek(144)=46then144,49
8621  m2=0:ml=0:m=0:pokel67,0
8625  xl$="":dl$=d$:print"";d$
8630  get#1,x$:m=m+1:ifx$=""then8630
8640  gosubl320:ml=ml+1
8650  ifx$=""thenprint" ":gosub8682:goto8690
8670  if x$=chr$(13) thenprint" ":gosub 8682:goto8625
8675  xl$=xl$+x$
8680  printx$;:goto8630
8682  if len(xl$)>len(d$)thenxl$=left$(xl$,len(d$))
8685  if len(xl$)<len(d$)thendl$=left$(dl$,len(xl$))
8686  ifxl$-dl$andlen(xl$)>lthenm2=m2+1
8688  return
8690  print"you typed";m2;"error-free lines.":goto9050
9000  print"BEGIN TYPING YOUR CHOICE WHEN READY"
9010  print"PRESS THE'-KEY TO STOP."
9012  openl,0
9020  ifpeek(144)=85thenpokel44,88:ifpeek(144)=46thenpokel44,49
9021  ml=0:m=0:pokel67,0
9023  get#1,x$:m-m+1:ifx$=""then9023
9024  gosubl320:ml=ml+1
9025  ofx$=""then9040
9026  ifx$=chr$(13)thenprint" ":goto9023
9027  printx$;:goto9023
9040  j2=m/25:print"you typed "int(ml/5)"words."
9041  yl=int((ml/5)/8):print"You typed";yl;"lines"
9050  ifpeek(144)=88thenpokel44,85:ifpeek(144)=49thenpokel44,46
9058  closel,0
9059  j2=m/25:print"YOUR SPEED IS"; int((ml/5)/(j2/60)); "WORDS PER
      MINUTE!"
9064  print"KEEP ON TRUCKIN'-EXCELLENCE IS ONLY A FEW STROKES
      AWAY"
9065  print"> > >PRESS SPACE BAR FOR MENU < < <";
9070  getk$:ifk$=""then9070
9080  run
ready
```

APPENDIX E.

INSTRUMENTATION

There are lots of terms that can tell us what a stroke ought to be. Some that are used are words such as darting, crisp, exact, and so on. A stroke is thought by some to be like the darting reach of a cat at a fly, or a crisp tennis drive, or a quick flicking of a speck off your hat or coat.

The complete tale is not told by these views; but they emphasize the two basic things: that a good stroke is firm and powerful and that your finger must not linger on a key. It might help to think of the key cap as being red hot; you must hit it, but you must release it before you get burned.

If you want quick strokes and the speed they carry, be sure to keep your fingers arched as though they were grasping the handle bars of a bicycle; keep your wrists so close to the other hand that your thumbs can lock simultaneously.

12		
24		
36		
48		
60		
12	72	
24	84	
36	96	
48	108	
60	120	
12	132	
24	144	
36	156	
48	168	

1 2 3 4 5 6 7 8 9 10 11 12

APPENDIX F.

SUITABILITY OF TYPEWRITING MATERIAL FOR TESTING

Please express your agreement or disagremeent with the following comments or statements:

1. In your opinion, is this (13-B Inventory p41, Typewriting Drills for Speed and Accuracy, Rowe-Etier, Canadian Edition, Gregg Division, McGraw-Hill Company of Canada. 1967) the kind or type of test commonly used to assess speed and accuracy in typewriting classes? (please circle one)

   YES NO

2. In your opinion, is the above material suitable for assessing speed and accuracy in Grade 9 beginning typewriting classes?

   YES NO

3. Would a proper method for scoring this test be to identify the number of errors made during a two or three minute timing?

   YES NO

4. In addition, would a proper method for scoring this material be to identify the total or gross speed per minute of typewriting?

   YES NO

5. A proper length of time for typing this material in a test condition, in a beginning typewriting course, would be two or three minutes.

   YES NO

6. A proper method of conducting the timing is to enable the student to attempt two consecutive timings on this material with a short rest period between timings.

   YES NO

7. Is testing material which has the Syllabic Intensity (SI) of 1.17, an appropriate level of difficulty for beginning typewriting students having experienced one or two months of typewriting instruction?

   YES NO

_____ _____

Signature Date

RESULTS: All 5 panelists circled YES on all statements.

APPENDIX G.

DEFINITION OF TECHNICAL VOCABULARY

1. Computer hardware, computer equipment: The physical apparatus comprising a computer system. These components include a central processing unit (CPU), memory, tape units, disk drives printers, terminals (teletypewriter, cathode ray tube (CRT), video display terminal (VDT)), printers and card readers.

2. Computer software, computer program: The instructional sets and data which direct computer hardware. The computer software, a series of specifically written instructions, direct the electronic hardware to perform useful functions, such as solving problems, or calculating arithmetically.

3. Computer language, program language: The notation for encoding computer programs. The program language used in this research is the Beginners All-purpose Symbolic Instruction Code, (BASIC), developed by Dartmouth College in 1963.

4. Microcomputer, microprocessor: The most recent stage in the development of the transistor has resulted in the current level of computer hardware. Several models are small, inexpensive, portable, easy-to-use, and are powerful, versatile and programmable.

Biographical Information

NAME: Robert McDonald Lindsay

PLACE AND DATE OF BIRTH: Campbellton, New Brunswick
August 14, 1935

EDUCATION (Colleges and Universities attended, dates, degrees)

University of British Columbia
Bachelor of Commerce 1960

University of British Columbia
Master of Arts 1982

POSITIONS HELD:

Teacher - New Brunswick	- 1959-1960; 1961-1963
Teacher - British Columbia	- 1963-1975; 1977-1982
Visiting Lecturer - Faculty of Education, U.B.C.	-1975-1977
Member - Summer Session - U.B.C	-1976
Part-Time Visiting Lecturer - U.B.C.	-1978
Tutor - Open Learning Institute	-1982

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AWARDS: Shelia E. Cameron Award Winner, May 10, 1980 "For an exemplary and outstanding contribution to business education in British Columbia".